
CALIFORNIA AIR RESOURCES BOARD

Work Program for U.S. EPA 105 Grant

FISCAL YEAR 2020

CARB

ENVIRONMENTAL PROTECTION AGENCY (EPA Region 9)

California Air Resource Board

Project Title: Remote Airborne Monitoring of Emissions from Ocean-Going Vessels

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Completion Date: January 2021 (estimate)

Project Description:

The California Air Resources Board (CARB) is the State agency responsible for protecting public health and the environment from the harmful effects of air pollution. CARB consists of 12 Governor-appointed and four Legislature-appointed Board members.

CARB oversees all air pollution control efforts in California, including the activities of 35 independent local air districts. State law vests CARB with direct authority to regulate pollution from motor vehicles, fuels, and consumer products. Primary responsibility for controlling pollution from business and industry lies with the local air districts. The federal government retains the exclusive authority to regulate interstate trucks registered outside California, certain new farm and construction equipment, new locomotives, ships, and aircraft. CARB works in cooperation with the districts and the U.S. Environmental Protection Agency (U.S. EPA) on strategies to attain State and federal ambient air quality standards and reduce air toxics emissions. CARB is also the lead agency for implementation of AB 32, the California Global Warming Solutions Act of 2006.

CARB programs continue to set the standard for innovative and effective air pollution mitigation in California. However, these programs can only achieve their projected benefits if they are properly and consistently implemented.

CARB's Ocean Going Vessels Fuels Regulation Enforcement program consists of an inspection program where records are reviewed, systems and procedures are

scrutinized, and representative fuel samples are taken to be analyzed at the CARB laboratory. The process by which an OGV compiles with the Fuels Regulation has weaknesses that can result in underestimation of emissions and failure to catch violations. To more effectively direct inspections, by utilizing remote monitoring capabilities before berthing, would be a huge advantage to current inspection procedures.

Project Partners:

CARB will partner with the Bourns College of Engineering at the University of California, Riverside (UCR) to advance CARB's Ocean Going Vessels (OGVs) Fuels Regulation Enforcement program to address program limitations by expanding capabilities with remote emissions monitoring.

UCR will be working with other regulatory agencies (DOT Maritime Administration, EPA, and air districts), and Universities (UC Los Angeles, Mechanical & Aerospace Engineering) to develop and implement remote emissions monitoring technologies to help maintain a level playing field, protect public health, and to help minimize emissions from OGVs visiting California's ports.

Program Priorities:

The proposed project focuses on the following priorities:

1. Testing Unmanned Aircraft Vehicles (UAVs) in CA waters. Recording in-stack plume emissions and characteristics including PM, SO₂, NO₂, NO, CO₂, Temperature, Air Pressure, and Humidity to select technologies that could be deployed.
2. Data collection on the types of technology used in the different phases, cost estimates for different aerial monitoring scenarios, and reports on the information collected over the course of the study.

Scope of Work

A. Background and Needs Description:

The regulatory environment affecting the US maritime industry is increasingly restrictive. When policies are set into practice the maritime industry may not have enough time and/or technical or economic resources to validate the proposed or implemented enforcement methodology/ies. This project frames the adaptation of tools to facilitate the validation of data used to enforce existing rules and regulations, allows for the enhancement of data verification of anticipated future regulatory requirements, and introduces promising quality control methods. For instance, there is a need for an on-board tool to verify fuel quality at the point of transfer and/or third party inspection findings.

Since 2013, EU authorities and their private sector partners have spent 30+ M euros to develop and test aerial monitoring of OGV emissions. These multi-national R&D

efforts have resulted in the deployment of several dynamic measurement systems in several air quality sensitive areas.

This protracted and focused effort has yielded positive results. EU countries that implemented both aerial monitoring as well as fixed sensor stations at strategic locations (e.g., bridge span across a sea straight) have seen significant drops in fuel quality violations as well as in air pollution. Of note is that in Norway and Belgium such programs are paying for themselves once initiated.

To date the US has not conducted the same level of research. As a result, despite having signed a binding agreement w/the International Maritime Organization (IMO, an arm of the UN), the US lags in the deployment of such systems. Part of this lag can be attributed to the need to customize such systems to US-specific geographic, regulatory, traffic and economic conditions. Of note is that each EU country that conducts OGV aerial monitoring is employing a system customized to its own needs.

B. Strategic Goals:

- Reduce or eliminate the impacts of pollution due to high sulfur content-in-vessel fuel;
- Ensure that there are compliance checks for OGVs sailing in CA waters that do not call in CA ports as well as OGVs in CA once they clear the breakwater;
- Quantify correlations between currently available air platform mounted sensor packages and certified emissions instrumentations (owned and operated by UCR CE-CERT and deployed under a separate project);
- Document incidence of OGV fuel quality violations sailing in and out of the Bay of SF;
- Document incidence of OGV fuel quality violations sailing in and out of the Bay of San Pedro.

This solution-focused project will:

- Provide effective means for data verification in maritime regulatory activities at anchor/berth and at sea;
- Help US-based regulatory entities (regional, state and federal) to cost-effectively enforce existing and soon-to-be-enacted air quality regulations (e.g. CARB, EPA, USCG, air districts);
- Prevent inadvertent non-compliance via innovative tools for fuel quality verification at pier and at sea (e.g. UAVs customized for maritime industry applications, portable XRF instruments, etc.);
- Determine cost of UAV-based aerial monitoring of OGVs in and near CA ports at various enforcement levels;
- Design and develop fuel cell propulsion solution to extend UAVs' dwell-over-target capabilities;
- Design and test alpha UAV prototype for long-range maritime missions; and
- Test portable XRF instrument as rapid quality control tool for fuel transfers & enforcement.

C. Project Tasks the contractor is responsible for:

Tasks (Part of Phase I for the total project):

Project 1 consists of eight tasks to be performed by UCR. A separate project performed by UCR CE-CERT will operate simultaneously to make in-situ measurements and calibrations. The eight tasks for the entire Project are as follows. EPA funding will be used to support Tasks 5, 6, 7, and 8.

Task/subtask	Begin	End
Conduct measurements of MV Cape Henry's emissions with BH-12 sensor package mounted on UAV	Month 1	Month 1
Record in-stack and plume emissions that include PM, SO ₂ , NO ₂ , NO, CO ₂ , Temperature, Air Pressure, and Humidity at several pre-determined distances from the stack	Month 1	Month 1
Compare measurements of S content with portable XRF instrument vs. lab bench XRF instrument.	Month 1	Month 3
Compare measurements of the XRF instruments vs. the calculated sulfur content results from the BH-12 sensor package emission numbers and vs. the CE-CERT generated emission numbers	Month 2	Month 4
Analyze data collected in this project to select technologies to be deployed in subsequent work.	Month 4	Month 7
Test hybrid drones	Month 5	Month 6
Develop model to estimate mortality and morbidity in affected communities	Month 5	Month 6
Participate in air quality conferences	Month 3	Month 7